VILLAGE OF MONSANTO, ILLINOIS

SPECIFICATIONS

FOR

THE CONSTRUCTION OF SEWERAGE IMPROVEMENTS

CONSISTING OF

THE DEAD CREEK INTERCEPTOR AND PUMPING STATION

IN

VILLAGE OF MONSANTO, ILLINOIS

Prepared by

HORNER & SHIFRIN
Consulting Engineers
St. Louis, Missouri

NOVEMBER 1965

65-75

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

ADVERTISEMENT FOR BIDS

SEWERAGE IMPROVEMENTS
DEAD CREEK INTERCEPTOR AND PUMPING STATION
VILLAGE OF MONSANTO, ILLINOIS
ST. CLAIR COUNTY, ILLINOIS

Sealed proposals for the construction of sewerage improvements will be received by the Village of Monsanto, Illinois, at the Village Hall, Falling Spring Road and Midwest Avenue, Village of Monsanto, Illinois, until _____ on _____ and then will be publicly opened and read.

The work consists of construction of a 15-inch interceptor sewer, a prefabricated pumping station, and a 10-inch force main, all with appurtenances, to be constructed to the area of the north end of Dead Creek in the Village of Monsanto, Illinois.

Plans and Specifications are on file and may be examined at the Village Hall, Monsanto, Illinois; the office of Horner & Shifrin, Consulting Engineers, 1221 Locust Street, St. Louis 3, Missouri; and at the offices of the Village Engineer, Joseph W. Goldenberg, 331 North Eighth Street, East St. Louis, Illinois. Copies of the Plans and Specifications may be obtained at the office of Joseph W. Goldenberg upon deposit of $20.00 for each set. Any unsuccessful bidder returning sets of the Plans and Specifications in good condition within ten days after the time set for the opening of bids will be refunded his deposit. Equipment manufacturers, subcontractors, and others who do not submit a formal proposal will be refunded one-half the amount of the deposit for all sets of Plans and Specifications returned in good condition within ten days after the time set for the opening of bids. No refund will be made for Plans and Specifications received after this ten-day period.

Each bidder must deposit with his bid, security in the amount of 5 per cent of the bid by cash, certified check of the bidder, or a bid bond.

A Performance Bond in the amount of 100 per cent of the total contract price will be required.

A Federal grant under Public Law 660 has been obtained. All contract provisions required under this law will be embodied in the Specifications.

Bidders on this work will be required to comply with the President's Executive Order No. 11114 and the provisions of Executive Order No. 10925 as included therein. The requirements for the bidders and contractors under this order are explained in the Specifications.

The Village of Monsanto hereby reserves the right to reject any or all bids or to accept the one that in its judgment will be for the best interest of the Village of Monsanto.

BOARD OF TRUSTEES
VILLAGE OF MONSANTO, ILLINOIS

By:

Leo Sauget, President

George J. Ogden, Village Clerk

PROPOSAL

_____
(Date)

Board of Trustees
Village of Monsanto
Illinois

Gentlemen:

In accordance with the foregoing advertisement inviting proposals for the Construction of Sewerage Improvements for Dead Creek Interceptor and Pumping Station, subject to the conditions and requirements of the General Conditions of the Contract, the Special Conditions of the Contract, the Specifications, including Addenda Nos. _____, _____, _____, and _____, hereto attached and the Plans which so far as they relate to the Proposal, are made a part of it, the undersigned herewith proposes to construct the specified work as follows:

To complete with project within ninety (90) calendar days after notice to proceed at the following unit prices:

1. Trench Excavation..... 1,490 cu. yd. @

$_____ (_____) $_____
(Figures) (Written Out) (Extension)

2. 15-Inch Vitrified Clay Pipe, Complete in Place ..... 1,078 lin. ft. @

$_____ (_____) $_____

3. 8-Inch Vitrified Clay Pipe, Complete in Place ..... 105 lin. ft. @

$_____ (_____) $_____

4. 10-Inch Cast Iron Pipe for Force Main, Complete in Place ..... 180 lin. ft. @

$_____ (_____) $_____

5. Manhole, Complete in Place, Depth less than 10 feet.... 1 each @

$_____ (_____) $_____

6. Manhole, Complete in Place, Depth 10 - 15 feet ..... 4 each @

$_____ (_____) $_____

7. Crushed Rock for Trench Subgrade Replacement ..... 10 tons @

$_____ (_____) $_____

8. Junction Chamber, Complete in Place ..... Lump Sum

(_____) $_____

9. Smith & Loveless Factory-Built Pumping Station, Complete in Place ..... Lump Sum

(_____) $_____

10. Gravel for Road Surface, In Place ..... 60 tons @

$_____ (_____) $_____

11. Lumber Ordered Left in Trench ..... 10 MFBM @

$_____ (_____) $_____

Total Project $_____

The Contractor proposes to (add) (deduct) _____

_____($_____)
to the unit price for Item 9 if a factory-built pumping station manufactured by _____ is substituted for the Smith & Loveless pumping station called for in Item 9.

The Contractor proposes to (add) (deduct) _____

_____($_____)
to the unit price for Item 9 if a factory-built pumping station manufactured by _____ is substituted for the Smith & Loveless pumping station called for in Item 9.

A bid deposit of not less than five per cent (5%) of this Proposal as called for in the advertisement for bids accompanies this Proposal. This sum is to be forfeited to the Village of Monsanto, Illinois, if the party, or parties, making this Proposal fail to enter into Contract with approved

securities within ten (10) days after the award of the Contract has been made.

The undersigned has examined the plans and specifications for, and the location of, the project, and has satisfied himself as to the work and the conditions under which it must be carried out.

The undersigned bidder (has) (has not) (strike out the term which does not apply) previously performed work subject to the President's Executive Orders No. 10925 and 11114.

This Proposal shall be equally binding on _____ heirs, administrators, executors, successors and assigns.

_____
Signature

_____

_____
Address

_____

_____
Telephone No.

GENERAL CONDITIONS

INDEX

1. DEFINITIONS:

(a) The Contract Documents consist of the Information to Bidders, the Proposal, the signed Contract Agreement, the Performance Bond, if required, the General Conditions, the Special Conditions, Drawings and Specifications, including all modifications thereof incorporated in the documents before their execution. These form the Contract.

(b) The Owner, the Contractor, and the Engineer, are those mentioned as such in the Contract Agreement. They are treated throughout the Contract Documents as if each were of the singular number and masculine gender.

(c) Wherever in this Contract the word Engineer is used, it shall be understood as referring to the Engineer of the Owner, acting personally or through an assistant duly authorized in writing for such act by the Engineer.

(d) The term Subcontractor, as employed herein, includes only those having a direct contract with the Contractor and it includes one who furnishes material worked to a special design according to the drawings or specifications of this work, but does not include one who merely furnishes material not so worked.

(e) The term "work" of the Contractor or subcontractor includes labor or materials or both, equipment, transportation, or other facilities necessary to complete the Contract.

2. EXECUTION, CORRELATION AND INTENT OF DOCUMENTS:

The Contract Documents are complementary, and what is called for by any one shall be binding as if called for by all. The intention of the documents is to include all labor and materials, equipment, and transportation necessary for the proper execution of the work. It is not intended, however, that materials or work not covered by or properly inferable from any heading, branch, class or trade in the specifications shall be supplied unless distinctly so noted on the drawings. Materials or work described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized standards.

3. NOTICE AND SERVICE THEREOF:

Where, in any of the Contract Documents, there is any provision in respect to the giving of any notice, such notice shall be deemed to have been given (as to the Owner) when written notice shall be delivered to the Engineer or the Owner, or shall have been placed in the United States mails, addressed to the Engineer, at the place where the bids or proposals for the Contract were opened; as to the Contractor, when a written notice shall be delivered to the chief representative of the Contractor at the site of the project to be constructed under the Contract, or by mailing such written notice in the United States mails, addressed to the Contractor at the place stated in the papers prepared by him to accompany his proposal as the address of his permanent place of business; as to the surety on the Performance Bond when a written notice shall have been placed in the United States mails, addressed to the surety at the home office of such surety.

4. COPIES OF DRAWINGS FURNISHED:

The Owner will furnish to the Contractor, free of charge, copies of drawings and specifications which are reasonably necessary for the execution of the work.

The Contractor shall keep one copy of all drawings and specifications on the work, in good order, available to the Engineer and to his representatives.

5. ORDER OF COMPLETION:

The Contractor shall complete any portion or portions of the work in such order of time as the Engineer may declare necessary by reason of an emergency.

6. CONTRACTOR'S UNDERSTANDING:

It is understood and agreed that the Contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of the equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters which can in any way affect the work under this Contract.

No official, officer or agent of the Owner is authorized to make any representations as to the materials or workmanship involved, or the conditions to be encountered, and the Contractor agrees that no such statement or the evidence of any document or plan, not a part of this Contract, shall constitute any grounds for claim as to conditions encountered. No verbal agreement or conversation with any officer, agent or employee of the Owner either before or after the execution of this Contract, shall affect or modify any of the terms or obligations herein contained.

It is understood and agreed that the Contractor has informed himself fully as to the conditions relating to construction and labor under which the work will be performed, and agrees as far as possible to employ such methods and means in the carrying out of the work as will not cause any interruption or interference with any other contractor.

7. MATERIALS, SERVICES AND FACILITIES:

(a) It is understood that except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all

materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete, and deliver the work within the specified time.

(b) Any work necessary to be performed after regular working hours, on Sundays or legal holidays, shall be performed without additional expense to the Owner.

8. "OR EQUAL" CLAUSE:

Whenever in any of the Contract Documents any article, appliance, device, or material is designated by the name of the manufacturer or vendor, or by any proprietary name and such name is not followed by the words "or equal", it shall be deemed that such words "or equal" do follow such designation, unless the context clearly requires a contrary construction. Any article or material equaling the standards fixed may be used in place of that specifically mentioned by the specifications, providing that the material proposed is first submitted to and approved by the Owner or his authorized representative.

9. ROYALTIES AND PATENTS:

The Contractor shall hold and save the Owner and his officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

10. SURVEYS, PERMITS AND REGULATIONS:

The Owner shall make all surveys unless otherwise provided. Permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured and paid for by the Contractor.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. The Contractor is required to observe all laws and ordinances relating to the obstructing of streets, maintaining signals, keeping open passageways and protecting them where exposed to danger, and all general ordinances affecting him or his employees or his work hereunder in his relations to the Owner or any person, and also generally to obey all laws and ordinances controlling or limiting the Contractor while engaged in the prosecution of the work under this Contract. If the

Contractor observes that the drawings and specifications are at variance with laws and regulations, he shall promptly notify the Engineer in writing, and any necessary changes shall be adjusted as provided in the Contract for changes in the work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules or regulations, and without such notice to the Engineer, he shall bear all costs arising therefrom.

11. PROTECTION OF WORK AND PROPERTY:

The Contractor must protect and support all water and gas pipes or other conduits, and all railway tracks, buildings, walls, fences, or other properties which are liable to be damaged during the execution of his work. He shall take all reasonable and proper precautions to protect persons, animals, and vehicles or the public, from injury, and wherever necessary, shall erect and maintain a fence or railing around any excavation, and place a sufficient number of red lights about the work and keep them burning from twilight until sunrise; and shall employ one or more watchmen as an additional security whenever they are needed. He must, as far as practicable and consistent with good construction, permit access to private and public property and leave fire hydrants and catch basins free from encumbrances.

12. INSPECTION AND EXAMINATION OF THE WORK:

The Engineer and his authorized assistants as well as all inspectors and other authorized personnel of any public agency under whose jurisdiction the work is being performed, shall have free access to the work at all times for inspection purposes, and shall be furnished by the Contractor, with facilities for ascertaining whether the work being performed or which has been completed is in accordance with the requirements of the drawings, specifications and contract, to the extent of uncovering, testing or removing portions of finished work.

Duly authorized inspectors acting in behalf of the Engineer and any public agency under whose jurisdiction the work is being performed, who shall perform their duties under the direction of the Engineer, will be assigned to the project or any part thereof. The presence of an inspector shall in no wise lessen the responsibility of the Contractor. In case any dispute arises between the Contractor and the inspector as to materials furnished or the manner of performing the work, the inspector shall have authority to reject materials or suspend the work until the question at issue can be referred to and decided by the Engineer. The inspector is not authorized to revoke, alter, enlarge, relax or release any requirements of these specifications, nor to approve or accept any portion of the work or to issue instructions contrary to the drawings and specifications.

SPECIAL CONDITIONS

1. SCHEDULE OF DRAWINGS:

The drawings applicable to the work to be performed under these specifications and which are referred to in these documents as Plans or Drawings, consist of six (6) sheets entitled "Village of Monsanto, Illinois, Sewerage Improvements," and are numbered and subtitled as follows:

Sheet No.	Title
1 of 6	Dead Creek Interceptor - Plan and Profile
2 of 6	Dead Creek Interceptor - Plan and Profile
3 of 6	Dead Creek Interceptor - Plan and Profile
4 of 6	Dead Creek Pumping Station - Plan and Section
5 of 6	Dead Creek Pumping Station - Sections and Details
6 of 6	Dead Creek Junction Chamber and Manhole Details

2. SANITARY REGULATIONS:

Adequate sanitary conveniences for the use of persons employed on the work, properly secluded from public observation, shall be constructed and maintained by the Contractor in such a manner and at such points as shall be approved by the Engineer. These conveniences shall be maintained at all times without nuisance and their use shall be strictly enforced. Upon completion of the work, they shall be removed from the premises, leaving the premises clean and free from nuisance.

3. CONTRACTOR'S AND SUBCONTRACTORS' INSURANCE:

The Contractor for this project shall not commence work under this Contract until he has obtained the insurance required under this paragraph and such insurance has been approved by the District, nor shall the Contractor or Contractors permit any subcontractor to commence work on his subcontract until the insurance required of the subcontractor has been so obtained and approved.

(a) Workmen's Compensation Insurance. The Contractor shall procure and shall maintain during the life of this Contract, Workmen's Compensation Insurance for all of his employees to be engaged in work on the project under this Contract and, in case any such work is sublet, the Contractor shall require the subcontractor similarly to provide Workmen's Compensation Insurance for all of the latter's employees to be engaged in such work unless such employees are covered by the protection

SECTION II

METHODS OF CONSTRUCTION AND PAYMENT

1. SCOPE OF WORK:

The work under this Contract shall include the construction of the Dead Creek Interceptor and Pumping Station.

Construction work included under these specifications shall be so planned and executed that the various portions of the work will be carried on concurrently and the whole completed within the time allowed.

The facilities to be constructed are located in easements which are to be obtained through private property. The rights-of-way will be provided by the Village of Monsanto, Illinois.

2. SHOP DRAWINGS:

In accordance with paragraph 4 of the Special Conditions, shop drawings shall be submitted for approval, including reinforcing steel details and electrical conduits. Accurate dimensions shall be shown for each item.

Payment for all work described in this paragraph shall be included in the bid item containing the various pieces of equipment or materials.

3. HANDLING OF MATERIALS:

All materials shall be delivered and distributed to the site of the work by the Contractor.

Items of electrical or mechanical equipment shall be delivered to the site only when the enclosure for the intended installation is completed to the extent to provide complete protection from the weather.

Payment for all work described in this paragraph shall be included in the bid item containing the various pieces of equipment or materials.

4. CONSTRUCTION IN EASEMENTS:

Where work is to be carried out in easements through private property, copies of the easements and agreements entered into with the

individual owners for permission to carry out the construction are on file in the Village Hall of the Village of Monsanto, Illinois. The Contractor should familiarize himself with the detailed provisions of these easements covering the working room,width of the easement, permission to store materials of construction and excavated materials adjacent to the easement along which the sewer is to be built, and the cleaning up and restoration of the surface upon completion of the work. The cleaning up and restoration of the surface upon completion of the work shall be carried out so that the surface of the ground within the easement shall be restored to its original condition or to the elevations as shown on the plans or as indicated by the Engineer.

The payment for all work described in this paragraph shall be included in the payment to be made for the Excavation, except that gravel surfaces to be restored shall be paid for at the applicable unit price bid as hereinafter described.

5. EXCAVATION - GENERAL:

The work included under Excavation shall comprise the clearing of the line, where necessary, on which sewers or structures are to be constructed; of making all excavations of all materials of every description which may be encountered; of furnishing and placing of all shoring, sheeting and bracing which may be necessary to protect the work and to execute it; of shaping the bottom; of furnishing all equipment which may be necessary to keep the trenches free from water so that the sewers and concrete may be placed in the dry; of providing for the uninterrupted flow of surface water or sewage adjacent to the line of the work during the progress of the work so as not to interfere with the natural surface flows; of protecting all pipes, conduits, culverts, bridges, and all other public and private property which may be endangered by the work and of removing, after the completion of the work, all shoring, bracing and sheeting not necessary to support the sides of the trenches.

All excavation shall be carried accurately to the line and grade as shown on the plans and as established by the Engineer.

The results of borings shown on the plans are for information only. There is no expressed or implied agreement or guarantee that depths or character of materials are correctly shown or that conditions affecting the work will not differ from those shown on the plans.

If the bottom of the excavation is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic materials considered unsuitable by the Engineer, the Contractor shall excavate and remove such unsuitable material to the depth required and backfill to the original

subgrade with granular backfill, well compacted in 6-inch layers. If over-excavation is required by the Engineer, the Contractor shall be paid for the over-excavation and backfilling. Any unauthorized over-excavation shall also be backfilled as described above, but no payment shall be made for such over-excavation and backfilling.

Where necessary to protect the labor, the work or adjacent property and in all vertical wall trenches deeper than 6 feet, the Contractor shall provide and install shoring. Such shoring shall remain in place until the backfill has proceeded to a point where it can be safely removed, except that if, in the opinion of the Engineer, damage is likely to result from withdrawing shoring, it shall remain in place.

All excavation shall be dewatered before any construction is undertaken therein. Concrete shall be placed only upon dry firm foundation material and pipe shall be laid only in dry trenches.

Payment for all work described in this paragraph shall be included with the various types of excavation described below.

6. EXCAVATION - STRUCTURAL:

The Contractor shall perform all structural excavation required on the plans for the factory-built pumping station, the concrete wet well, and the junction chamber. Excavation shall extend a sufficient distance from walls and footings to allow for forms for the work and for proper inspection, except where the plans indicate that concrete may be deposited directly against excavated surfaces.

Payment for all work described in this section shall be included in the cost of the item for the Factory-Built Pumping Station, or the Junction Chamber, except that authorized over-excavation shall be paid for at the rate of $5.00 per cubic yard of excavation actually removed and backfilled. This payment for over-excavation shall include all labor, material and equipment for excavating the material and the backfilling as specified above.

7. EXCAVATION - TRENCH FOR SEWER PIPE:

In order to avoid superimposed loading in excess of the designed and specified pipe strength and to provide sufficient room for proper installation and bedding of sewer pipe, the trench widths for the pipe sizes used shall be kept within the limits specified as follows:

Inside Pipe Diameter (Inches)	Min. Width of Trench at Center of Pipe (Inches)	Max. Width of Trench 12 Inches Above Extrados of Pipe (Inches)
6 - 8	20	30
10 - 12	24	30
15 - 18	30	34

If the Contractor wishes to reduce the earth load on the trench banks to prevent sliding and caving, it will be permissible to cut the trench banks back on a slope above an elevation 2 feet above the outside top of the pipe, except as noted below. Under no circumstances, however, shall the specified maximum width 12 inches above the extrados of the pipe be exceeded, except at points where the combined superimposed earth and live loads on the pipe are sufficiently low to permit an increase in the specified maximum trench width, and then only where such an increase in trench width is authorized in writing by the Engineer.

Only braced vertical trenches will be permitted in streets, alleys or easements which are paved.

Except where special bedding is required and except as specified herein, rough excavation for sewers shall not be carried lower than a distance equal to 1/10 of the nominal pipe diameter or 2 inches, whichever is the greater, above the specified trench grade elevation, and the remainder of the excavation shall be done by the pipe layer immediately prior to installing the pipe, using the final excavation to firm up on each side of the pipe previously laid. Where the trench bottom is hard clay or other material that cannot be readily handled by the pipe layer, the last 2 inches may be loosened by hand ahead of the pipe layer but shall not be removed from the ditch. The bottom of the trench shall be generally shaped to fit the outside surface of the pipe in such a manner that the pipe will be in continuous contact with, and have a longitudinal bearing on the soil for the full length of the pipe, except for such distance as is necessary for bell holes and the proper sealing of the pipe joints. In any case the longitudinal bearing of the pipe on soil shall be not less than 3/4 of the distance between pipe joints. The pipe subgrade shall be accurately graded prior to excavating bell holes. The accuracy of the finished grade of the pipe shall be obtained in preparation of the subgrade. A bell hole for each joint shall be excavated by the pipe layer immediately prior to placing the pipe in the trench. Bell holes shall be of such depth that the pipe bell will not come in contact with the bottom of the bell hole. All trenches shall be so graded that the spigot end of the pipe will be accurately centered in the adjacent

pipe bell when laid, without raising or lowering the pipe after installation in the trench.

If the soil at the bottom of the trench is mucky or in such condition that it cannot be properly shaped and graded, or if the subgrade material is too soft to properly support the pipe, the Contractor shall excavate below the normal subgrade elevation as directed by the Engineer. Wherever excavation is carried below the specified subgrade, the Contractor shall provide and install a fill thoroughly tamped into place up to an elevation sufficient to prepare the subgrade as specified in the preceding paragraph.

Where water occurs in trenches, they may be excavated to a depth of approximately 6 inches below grade and backfilled with crushed rock to a point approximately 1/10 of the internal pipe diameter or 2 inches, whichever is the greater, above grade. Pumps may then be kept operating, taking suction out of a sump below the crushed rock so as to hold the water level well below the bottoms of all bells until the joints have been placed. Other means of dewatering the trenches may also be used but the trench subgrade shall be stable and dry when the pipe is laid.

Where rock or other hard material occurs in the trench at the planned grade of the bottom of the pipe in such way that any portion of the pipe would rest on rock, or hard material, or where in the opinion of the Engineer it is necessary, the excavation shall be carried to a depth of 6 inches below the planned grade. The trench shall then be refilled with crushed rock thoroughly compacted to a point approximately 1/10 the nominal pipe diameter, or 2 inches, whichever is the greater, above grade and the bottom of the trench hand-graded as previously specified.

The Contractor will be required to keep the sides of the excavation vertical, except as hereinbefore provided. Shoring shall remain in place until the backfill has proceeded to a point where it can be safely removed, except that if, in the opinion of the Engineer, damage is likely to result from withdrawing sheeting and shoring, it shall remain in place.

All trench excavation for sewers shall be unclassified.

Excavation in trenches for sewers will be measured as the cubic yards within the payline width of trench, the payline depth of trench and the length of trench, dug for sewers. The payline width for the various sizes of sewer line shall be equal to the maximum width of trench permitted 12 inches above the extrados of the pipe as tabulated above. The payline depth of trench shall be measured as the vertical distance between the original ground surface and the invert of the sewer pipe plus the depth of any over-excavation authorized by the Engineer to control water in the trench, replace unsuitable subgrade material, or remove rock or other

hard materials. The length of trench dug for sewer lines shall be the horizontal distance of trench actually excavated measured along the pipe line.

Excavation shall be paid for per cubic yard of excavation measured times the unit price bid for "Trench Excavation." The unit price for "Trench Excavation" shall include all clearing, shoring, dewatering, bedding, backfilling, maintenance of backfill and all other work included in this paragraph except cutting and replacing paved surfaces, shoring authorized left in place and crushed rock for trench subgrade for authorized overexcavation.

8. EXCAVATION - TRENCH FOR FORCE MAIN:

Trenches shall be dug so that the force main can be laid to the alignment and depth required. Trenches shall be braced and drained so that the work may be carried on safely and efficiently. The width of trenches shall be ample to permit the pipe or conduit to be laid and jointed properly and the backfill to be placed and compacted. Where sheeting and bracing of the trench is required, the trench shall be of such additional width as to permit placing of the pipe between the sheeting and bracing.

Bell holes shall be provided in the trench to relieve the bells of all strain.

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and uninterrupted ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage the subgrade surface near the middle of each length of cast iron pipe to permit the withdrawal of pipe slings or other lifting equipment for handling the pipe. Any part of the bottom of the trench excavated below the specified subgrade shall be backfilled with crushed rock thoroughly compacted as directed.

The force main shall have the cover shown on the plans.

Where the bottom of the trench at subgrade is found to be unsuitable for the subgrade upon which the pipe is to be laid, the Contractor shall excavate and remove such unsuitable material to the depth required before the pipe is laid. Backfilling of over-excavation shall be carried out as specified above.

All trench excavation for the force main shall be unclassified.

Excavation in trenches for force main will be measured as the cubic yards within the payline width of trench, the payline depth of trench

and the length of trench dug for the force main. The payline width for the 10-inch force main shall be 30 inches. The payline depth of trench shall be measured as the vertical distance between the original ground surface and the bottom of the force main plus the depth of any over-excavation authorized by the Engineer to control water in the trench, replace unsuitable subgrade material or remove rock or other hard materials. The length of trench dug for the force main shall be the horizontal distance of trench actually excavated measured along the force main.

Excavation shall be paid for per cubic yard of excavation measured times the unit price bid for "Trench Excavation." The unit price for "Trench Excavation" shall include all clearing, shoring, dewatering, bedding, backfilling, maintenance of backfill, and all other work included in this paragraph except cutting and replacing gravel surfaces, shoring authorized left in place and crushed rock for trench subgrade for authorized over-excavation.

9. BACKFILL:

Except as otherwise specified or required, all backfill shall be made with suitable earth free from debris, lumps, and perishable materials in quantities considered excessive by the Engineer. No frozen material shall be placed as backfill nor shall backfill be placed upon or against frozen surfaces. All materials shall be placed by methods hereinafter specified or as otherwise approved by the Engineer. Backfill shall not be placed upon or against concrete surfaces, prior to 14 days after placing of the concrete and then only after approval of the Engineer. Backfill shall be brought up evenly on each side of structures as far as practical. Prior to placing backfill, forms for concrete shall be removed and the excavation shall be cleaned of trash and debris.

Backfill to be placed around structures shall be placed in uniform horizontal layers not to exceed 12 inches in thickness before compaction. Each layer shall be compacted with approved mechanical tampers before the next succeeding layer is placed.

The backfilling of completed vitrified clay sewers shall commence immediately upon the completion of the sewer, with care being taken that the operation of backfilling does not disturb the pipe joints. The initial backfilling of the trench over and around pipe sewers shall be placed in 6-inch layers which shall be thoroughly hand-tamped to an elevation not less than one foot above the extrados of the pipe. The material used for this initial backfilling shall be the excavated natural soil free from all other foreign substances. No cinders or ashes shall be used. No walking over the completed pipe sewer will be allowed until the backfill has been carried to at least one foot above the top of the sewer. In lieu of tamping the backfill, the Contractor may, at his own option and at his own expense,

complete the backfill to one foot above the top of the sewer with limestone screenings of the type specified in Section I of these specifications.

Where the sewer construction takes place in unpaved areas, the backfill for the balance of the depth of the trench above one foot over the top of the completed sewer may be carried out in one operation to the surface. After backfilling, such settlement as may occur shall be filled with surplus material with the surface of the backfilled trench restored to the elevation existing before the work commenced. Where sewer construction takes place under gravel surfaces, the backfill shall be jetted, flooded or otherwise consolidated as approved by the Engineer.

Backfilling for cast-iron pipe shall be the same as described above except that tamped backfill shall need to be brought up only to the springline of the pipe.

All excavation not required for backfilling shall be disposed of, as directed by the Engineer, by spreading it around the site.

The cost of all work included in this paragraph shall be included with the cost of the excavation requiring the backfilling operation.

10. LUMBER LEFT IN TRENCH:

Lumber used as shoring for trenches may be required to be left in place by the Engineer to prevent damage likely to occur if the shoring is removed.

Lumber left in trenches shall be measured as the MFBM of wood shoring authorized by the Engineer to be left in place and shall be paid for at the unit price bid for "Lumber Ordered Left in Trench."

The unit price for "Lumber Ordered Left in Trench" shall include all labor, material and equipment to install, cut off, and all other work necessary for the lumber authorized to be left in place.

11. CRUSHED ROCK FOR TRENCH SUBGRADE:

Where necessary, in the opinion of the Engineer, to excavate below the planned subgrade for pipe lines, the over-excavation shall be back-filled with crushed rock well compacted in 6-inch layers.

Only crushed rock placed in over-excavation authorized by the Engineer will be measured and paid for as "Crushed Rock for Trench Subgrade Replacement." Crushed rock placed in over-excavation not authorized by the Engineer shall be included in the cost of the excavation.

Crushed rock for trench subgrade to be measured and paid for shall be measured as the tons of crushed rock actually placed in the trench and shall be paid for at the unit price for "Crushed Rock for Trench Subgrade Replacement."

The unit price for "Crushed Rock for Trench Subgrade Replacement" shall include all labor, materials and equipment to place the crushed rock as required by these specifications.

12. CONCRETE:

The Contractor's attention is called to the fact that the specifications for Class A and Class B concrete carry three limiting factors, all of which shall be complied with. These factors are: (1) minimum strength, (2) minimum volume of cement per cubic yard of concrete, and (3) maximum volume of water per sack of cement.

Classes of Concrete. Class B concrete may be used for blocking for cast-iron pipe or for encasement of sanitary sewers or drain lines. All other concrete used on this project shall be Class A concrete, unless otherwise specifically noted on the plans.

Class A Concrete. Class A concrete shall have a minimum compressive strength of 3,500 pounds per square inch in 28 days and shall consist of the mixture which results in one cubic yard of concrete to each batch of fine and coarse aggregate and water used to each six sacks of cement. Total water shall be limited to a maximum of 6-1/2 gallons per sack of cement. The fine and coarse aggregates for each batch of concrete where monolithic construction is to be carried out shall be accurately weighed; the exact weight of each batch shall be that necessary to produce a dense workable concrete with the yield per sack of cement as herein specified when mixed within the limitations of the amount of water herein specified. Where small batches of concrete are to be used and the concrete is mixed on the site, Class A concrete shall be considered as that mixture consisting of 2 cubic feet of dry fine aggregate, not more than 3-1/2 cubic feet of dry coarse aggregate to each sack of cement, mixed with not more than 6-1/2 gallons of total added water.

Class B Concrete. Class B concrete shall have a minimum compressive strength of 2,000 pounds per square inch in 28 days and shall consist of the mixture which results in one cubic yard of concrete to each batch of fine and coarse aggregate and water used to each four sacks of cement. Total water shall be limited to a maximum of 8-1/2 gallons per sack of cement. Where small batches of concrete are to be used and the concrete is mixed on the site, Class B concrete shall be considered as that mixture consisting of 3 cubic feet of dry fine aggregate, not more than 5

cubic feet of dry coarse aggregate to each sack of cement, mixed with not more than 8-1/2 gallons of total added water.

Determination of Added Water. In determining the amount of added water, allowance should be made for the moisture content in the aggregates. In measuring the fine aggregate by volume for small batches of concrete, if the aggregate is wet, allowance should be made for the bulking on account of the presence of moisture.

Proportioning. The concrete mixtures will be approved by the Engineer, from design mix tests, which will determine the required quality of the concrete as covered by these specifications. All materials required for these tests shall be supplied by the Contractor from samples taken from the approved source of supply. At any time during the construction period, the relative weights of fine and coarse aggregates as determined by the original mix design may be varied slightly in order to ensure the use of the least amount of fine aggregate which will produce workable concrete with the slumps specified.

The water content of the concrete shall at all times be the minimum necessary to properly place the concrete. It shall be regulated as required to adjust for any variation in the moisture content or grading of the aggregates. Addition of water to compensate for stiffening of the concrete before placing will not be permitted. Uniformity of concrete consistency from batch to batch will be required.

All concrete shall be proportioned by weight. Allowance must be made for the weight of moisture in the aggregates in order to determine the amount of additional water required for the given concrete mix design.

Air-Entrained Concrete. No admixture other than an approved air-entraining admixture shall be used in the concrete. The air-entraining admixture, if used, shall be added to the concrete during the process of mixing. The agents shall be accurately measured and dispensed by means of an approved adjustable mechanical dispenser which will automatically and gradually discharge the required amount of material into the mixing water. The entire amount of air-entraining agent shall be fully discharged before all of the mixing water has entered the drum of the mixer. The dispenser shall be so constructed that it can be accurately calibrated for the quantity of agent discharged at various settings and shall be provided with means by which the discharge can be readily diverted from the stream of mixing water to a container for measurement.

Class A concrete in which an air-entraining admixture is used shall contain 5 per cent plus or minus 1 per cent of entrained air by volume. The volume of entrained air in the freshly mixed concrete will be measured

by the Engineer by the volumetric method, Test for Air Content of Freshly Mixed Concrete by the Volumetric Method, ASTM Designation C173, or by the pressure method, Test for Air Content of Freshly Mixed Concrete by the Pressure Method, ASTM Designation C231. Mixes will be designed for the recommended air content and adequate control shall be provided to keep the air content within the required limits.

Consistency. The consistency of the concrete shall be such that the slump, when measured according to Test for Slump or Portland Cement Concrete, ASTM Designation C143, is the lowest compatible with workability and ease of placing. In general, the slump shall not exceed the following:

Kind of Work	Maximum Slump in Inches
Mass Footings and Slabs	3
Thin Slabs and Thick Walls	4
Wall 15-Inch and Thinner	4-1/2

No additional water shall be added at the site of placement except with permission and under strict supervision of the Engineer and then only in an emergency. Such additional water shall be added only in small increments and then only in the smallest amount necessary within the required limits of consistency for the particular work, and shall be uniformly mixed and incorporated into the unplaced concrete before deposition in the forms.

Mixing. Concrete required for blocking, encasement and other uses incidental to the installation of pipe involving small quantities may either be mixed by machine or by hand. All other concrete shall be mixed by machine.

Mixing by Machine. The mixer to be used shall be so designed as to take one complete batch of materials using whole bags of cement only and to mix that batch thoroughly before any portion of it is withdrawn and any portion of the succeeding batch is introduced. In no case shall the volume of the batch to be mixed be greater than the amount of materials which can be loaded and mixed in the mixer without any loss during the loading or mixing by spilling. The mixer shall be equipped with a water tank accurately calibrated so that the required amount of water can be added to each batch, and with a batch meter or other suitable attachment for satisfactorily locking the discharging device so as to prevent the emptying of the drum until all of the materials have been mixed together for the minimum time required.

After all the ingredients, including water, have been placed in the drum, they shall be thoroughly mixed in the mixer for a period of not less

than one minute. During this period the drum shall make not less than 14 nor more than 20 revolutions per minute.

Central Plant Concrete Mixing. In lieu of mixing on the job by machine or by hand, central plant concrete will be permitted, provided the concrete conforms to the proportioning hereinbefore specified, is mixed at a central plant or in transit in equipment approved by the Engineer, and in conformity with current ASTM Specifications for Ready-Mixed Concrete (C94). The concrete shall be delivered to the job in batches of such size that it can be conveniently handled without setting up during placing, without segregation of aggregates, and of satisfactory consistency to ensure a uniform concrete mixture when placed.

Hand Mixing. Where hand mixing of concrete is permitted, it shall be carried out on watertight boards or pans in not more than 2-sack batches. The cement and fine aggregates shall first be mixed dry until a uniform color is obtained. The water shall then be gradually added and the mixture made into a mortar, adding additional water until the desired consistency is reached. The coarse aggregate shall then be spread upon the mortar and covered with mortar. The whole mass shall then be cut through and turned over not less than four times or until thoroughly mixed with a uniform homogeneous mixture obtained before being removed from the mixing board or pan in the place where it is to be deposited. The total amount of water shall not exceed the limitations hereinbefore specified for Class A or Class B concrete.

Forms. Forms for concrete shall be rigidly braced so that they cannot bulge or warp and leave an unworkmanlike finished surface. They may be constructed of any material with sufficient strength which will give the finished work a satisfactory surface. They must be sufficiently tight so that mortar cannot escape from the concrete in appreciable quantity. Forms shall be cleaned and be thoroughly moistened or treated with form oil before concrete is placed. All exposed exterior concrete corners shall be chamfered one inch.

Reinforcing. All reinforcing shall be rigidly fastened in the forms prior to the pouring of any concrete in such manner that the steel will be held accurately to the location shown on the plans. Steel shall be cleaned of rust, scale, oil, or other surface matter before being placed in forms.

Wall Fittings and Anchor Bolts. Wall fittings and anchor bolts shall be installed as shown on the plans.

Placing. The methods and equipment used for transporting concrete and the time that elapses during transportation shall be such as will not

cause appreciable segregation of coarse aggregate, or slump loss in excess of 1 inch in the concrete as it is placed in the project.

Before placing concrete in the forms or in the place of deposit, all debris and foreign materials, soft earth, or mud, shall be removed. Water shall be removed from the place of deposit. No concrete shall be placed in water. Steel or wood forms shall be oiled and treated to prevent adhesion of concrete and damage to the concrete surface upon removal of the forms. Concrete shall be placed as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the forms and around reinforcing. No concrete shall be used that has partially hardened or has been contaminated by foreign material or that has been retempered. Placing of concrete shall be performed only in the presence of a duly authorized representative of the Engineer unless inspection is waived in each specific case.

The temperature of concrete when it is being placed shall be not more than 90 degrees F. or less than 40 degrees F. and shall not have attained an initial set.

All concrete shall be thoroughly compacted by vibrators, spading or other suitable means during the operation of placing, to ensure that concrete will flow around all reinforcement, embedded fixtures and into the corners of the forms to give a dense finished product with true surfaces free from honeycombing, segregation and other imperfections. Concrete shall be placed in horizontal layers of no greater depth than 18 inches. Concrete shall be placed at a suitable rate to avoid the formation of unauthorized cold joints. In no case shall vibrators be used to transport the concrete inside the forms.

Care shall be taken when placing concrete through reinforcing steel so that the segregation of coarse aggregate is kept to a minimum. In such cases, spouts, elephant trunks, or other suitable means shall be used. The free fall of concrete shall be held to a practical minimum and shall not exceed 5 feet at any time.

The placing of concrete shall be so planned that horizontal and vertical construction joints are made where shown on the drawings or where approved by the Engineer. Structural keys shown on the plans shall have a minimum width of 4 inches and a depth of 1-1/2 inches. The concrete shall be left with a roughened surface for construction joints. Waterstops shall be placed as shown on the plans and in all construction joints subject to water on one side and where the opposite side is intended to be dry.

Tests. The Contractor shall provide for test purposes, one set of four cylinders taken from each day's pour of each class of concrete poured, except that pours of Class B concrete of less than 3 cubic yards need not be tested. The test cylinders shall be made and cured in accordance with ASTM Specifications C31. Two cylinders shall be broken at 7 days and two cylinders at 28 days, in accordance with ASTM Specification C39.

Protection. The Contractor shall protect all concrete against injury until final acceptance by the Engineer.

During cold weather all concrete materials and all reinforcement, forms, fill material, and ground with which the concrete will be placed in contact, shall be free of frost or ice and snow. Whenever the temperature of the surrounding area is 40 degrees F. and falling, no concrete shall be placed unless the Contractor has on hand sufficient, suitable, and approved means of protecting the concrete. Whenever the temperature of the surrounding air is between 40 degrees F. and 32 degrees F., all concrete placed in the forms shall have a temperature between 50 and 70 degrees F. Adequate means shall be provided for maintaining a temperature in the surrounding air not less than 70 degrees F. for at least three days, or 50 degrees F. for five days. The housing, covering, or other protection used shall remain intact and in place at least 24 hours after artificial heating is discontinued. Care must be used to prevent fire hazards when using heating and no fire or excessive heat shall be permitted near or in direct contact with concrete at any time. Salt or chemicals shall not be used in the concrete to prevent freezing.

Whenever the temperature of the surrounding air reaches 32 degrees F., or lower, concrete shall not be placed except with the approval of the Engineer who shall state the time in addition to that specified herein that artificial heat and protection must be supplied. Whenever the temperature of the surrounding air reaches 20 degrees F. or lower, no concrete shall be placed except for emergencies and only with special permission and supervision of the Engineer.

Curing of Concrete. All concrete placed when the temperature is above 40 degrees F. shall be either sprinkled continuously for 72 hours, or shall be covered with burlap which shall be kept moist for at least 72 hours. The use of membrane curing shall also be permitted only when approved by the Engineer. The membrane curing compound shall be of a type approved by the Engineer.

Concrete cured with water shall be kept continually wet for at least 72 hours immediately following placement of the concrete, or until covered with fresh concrete. The concrete to be cured shall be kept wet by covering

with water-saturated material or by a system of perforated pipes, mechanical sprinklers, or porous hose, or by any other approved method which will keep all surfaces to be cured continuously (not periodically) wet. Water curing shall commence as soon as the concrete has hardened sufficiently to prevent damage. Water used for curing shall meet the requirements for water used for mixing concrete.

Membrane curing compound shall be applied to formed surfaces immediately after the forms are removed. If any areas require patching, or any other surface treatment, the membrane curing shall not be applied to that area until after the area has been repaired. The area to be repaired shall be kept continually wet in a method approved by the Engineer prior to the patching or surface treatment of the area. Following the patching or surface treatment and a 24-hour period of water curing, the area may, at the Contractor's option, be treated with membrane curing compound for the remainder of the curing period.

Any membrane curing compound applied to surfaces that require patching or other surface treatment, or to surfaces that are specified to be water cured as listed above, shall be completely removed by sand blasting.

Where membrane curing is used, following removal of the forms, the surfaces shall be thoroughly moistened with water and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water disappears or immediately following finishing where special finishing operations are specified. The curing compound shall be applied in a two-coat continuous operation by approved power-spraying equipment and at a uniform coverage of not more than 300 square feet per gallon for each coat. All concrete surfaces on which the curing compound has been applied, shall be adequately protected for a period of 72 hours from any cause which will disrupt the continuity of the curing membrane. Any curing membrane damaged during the 72-hour period, shall be restored as directed by the Engineer.

Finishing. Immediately after removing the forms, all fins or irregular projections shall be removed from all surfaces. On all surfaces the area of cavities produced by form ties, holes, honeycombing, broken edges or corners, and other surface defects, shall be cleaned and carefully filled, pointed, and troweled to a true uniform smooth surface with sand-cement mortar mixed in the proportions used in the grade of concrete being furnished. Defective concrete as determined by the Engineer shall be repaired by cutting out the unsatisfactory material and placing new concrete which shall be secured with keys, dovetails or anchors. Concrete for patching shall be drier than the usual mixture and shall be thoroughly tamped into place.

All exposed concrete surfaces shall be finished in the following manner: Forms shall be removed from such surfaces as soon as structurally possible, as approved by the Engineer, and all depressions or imperfections immediately patched as described above. All fins shall be removed. No rubbing shall be required.

No mortar or wet cement shall be used in finishing except the mortar necessary to fill imperfections. Edging tools shall be used on all exposed top edges.

Payment. Payment for all work in this paragraph shall be included in the cost of the various items with which the concrete is used and no concrete or reinforcing steel shall be measured or paid for separately.

Concrete and reinforcing steel for the pumping station base and the wet well for the pumping station shall be included in the price bid for "Factory-Built Pumping Station."

Concrete and reinforcing steel for the Junction Chamber and the concrete pier for the 10-inch force main in Dead Creek shall be included in the price bid for the "Junction Chamber."

Concrete in manholes shall be included in the price bid for manholes of the various depths listed in the Proposal.

Concrete for blocking behind bends of the force main shall be included in the price bid for "10-Inch Cast Iron Pipe for Force Main."

13. INSTALLATION OF VITRIFIED CLAY SEWER PIPE:

Vitrified clay sewer pipe shall be laid with the bell uphill to the line and grade given by the Engineer on a prepared subgrade excavated and shaped as hereinbefore described. The prepared subgrade shall be kept free from water during the laying of the pipe.

The material used in jointing the pipe shall be as indicated in Section I of these specifications.

As the work progresses, the interior of the sewer shall be cleaned of all dirt or debris of any description.

Pipe shall be laid through line manholes, and the upper half removed after the invert is completed, unless half-pipe is used.

Vitrified clay pipe shall be so handled and stored that the jointing material will not be deformed or damaged. The joints shall be connected

by first brushing the proper lubricant sealer on the clean mating surfaces as recommended by the pipe manufacturer. The spigot end shall be centered on grade into the bell end of the downstream pipe and shoved "home." The pipes shall be joined not later than five minutes after the application of the lubricant sealer.

All vitrified clay pipe shall be laid and handled so that the allowable infiltration shall not be exceeded.

The 20-inch vitrified clay pipe for the pumping station overflow will be included in the unit price for the "Factory-Built Pumping Station." All other vitrified clay pipe will be measured and paid for as such. Each size of vitrified clay pipe shall be measured and paid for at the corresponding unit price bid for each particular size pipe installed. Pipe shall be measured along the top centerline of the pipe between the centers of manholes.

The unit price for vitrified clay pipe of the various sizes shall include all material, labor and equipment necessary to install and test the vitrified clay pipe complete in place in accordance with these plans and specifications.

14. INSTALLATION OF CAST-IRON PIPE:

Handling Pipe. Cast-iron pipe shall not be dropped, let roll and collide with another pipe, or be subjected to any unnecessary jar, impact, or other treatment that might crack or otherwise damage the pipe while being transported, unloaded or handled. Proper and suitable tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Care shall be taken to prevent any coating on the inside of pipe and fittings from being damaged. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be defective. If a defective piece should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor at his expense.

Cutting Pipe. Cutting of cast-iron pipe shall be done in a neat manner, without damage to the pipe or to the cement lining therein. Pipe cuts shall be smooth, straight, and at right angles to the pipe axis. All cutting of pipe shall be done with mechanical pipe cutters.

Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the completed work. All lumps, blisters, and excess coating shall be removed from the exterior spigot and interior bell surfaces of pipe with mechanical or push-on joints. Such surfaces shall be wire-brushed and wiped clean and dry and free from oil and grease before

placing the spigot in the bell. All joint contact surfaces shall be kept clean until the jointing is completed. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. No debris, tools, clothing or other materials shall be placed in the pipe.

Inspection. During installation, while suspended and hanging free, each pipe and fitting shall be inspected for defects and rung with a light hammer to detect cracks. All defective, damaged or unsound pipe and fittings shall be rejected and removed from the site of the work.

Installation in Trench. Before laying pipe in the trench, the bottom of the trench shall be carefully graded and prepared and bell holes excavated so that the pipe shall have a uniform support along its entire length except at bell holes, and shall not be allowed to rest on hard supports through a portion of its length only. The cover over the pipe shall be a minimum of 36 inches unless otherwise designated on the plans. At all times when pipe laying is not actually in progress, the open ends of the pipe shall be closed by temporary watertight plugs or other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

The force main shall be laid with a continuous positive slope from the pumping station to the discharge end of the line.

Concrete anchorage or blocking shall be placed behind all tees and bends to undisturbed earth in the trench. Concrete shall be placed in such a manner that joints can be maintained unless specific permission of the Engineer has been obtained to encase them.

Blocking behind tees and 90-degree bends shall be such that an area of concrete three times the cross section of the pipe shall bear against undisturbed earth. All other bends shall have 50 per cent of the above requirement.

Mechanical Joints. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations using torque wrenches in accordance with ASA Specification A21.11. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned and reassembled. The Contractor will not be permitted to overtighten bolts in order to compensate for poor installation practice. Joints to be deflected shall be made up in a straight line and then deflected prior to the tightening of the nuts with the ratchet wrench.

Push-On Joints. Push-on joints shall be carefully assembled in accordance with the manufacturer's recommendations regarding gasket installation and other jointing operations.

Flexible Couplings and Flanged Adapters. Flexible couplings and flanged adapters shall be installed in accordance with the manufacturer's printed instructions and shall make watertight joints in the pipes being connected. Stud bolts, harnesses, rods or other approved devices shall be utilized as necessary to prevent the pipe from pulling apart at flexible joints.

Payment. The 10-inch cast-iron pipe for the force main shall be measured and paid for within the limits of payment for Item 4 shown on the plans. The remainder of the 10-inch cast-iron force main and all other cast-iron pipe shall be included in the cost of the "Factory-Built Pumping Station" or the "Junction Chamber" corresponding to the structure of which it is a part.

The cast-iron pipe for the force main to be measured and paid for as "10-Inch Cast-Iron Pipe for Force Main" shall be measured along the top centerline of the pipe actually installed and shall be paid for at the unit price bid for "10-Inch Cast-Iron Pipe for Force Main."

The unit price for "10-Inch Cast-Iron Pipe for Force Main" shall include all material, labor and equipment necessary to install the force main including pipe and fittings, jointing of pipe and concrete blocking for bends.

15. BRICK MANHOLE CONSTRUCTION:

Manholes shall be built of brick to the dimensions and at the locations as shown on the plans or as directed by the Engineer, as rapidly as the construction of the sewer will permit. All bricks in each course shall be headers and break joints with those in the adjoining course. Each brick shall have full mortar joints on the bottom and sides, which shall be formed at one operation by placing sufficient mortar on the bed and forcing the brick into it. Horizontal joints shall not exceed 3/8 inch and vertical joints on the inside of the manholes shall not exceed 1/4 inch.

The mortar for the brick work of the manholes shall be made of one part of portland cement and three parts of sand, complying with the fine aggregate specifications hereinbefore described. The sand and cement shall be thoroughly mixed dry, and the necessary quantity of clean water shall be added so as to produce a stiff mortar of the proper consistency, which mix shall be thoroughly worked with proper tools.

All joints on the inside of the manholes are to be carefully rubbed full and struck as the manhole is built up. Upon completion of each manhole, all waste mortar and debris shall be immediately removed from the bottom and the invert shaped to the dimensions shown on the plans and all

bottom joints struck or pointed. The jointing of the brick work shall be such that the manhole will be watertight so that no ground water infiltration through the manhole joints will occur. The outside of the manhole shall be covered with a mortar plaster coat 1/2 inch thick.

A single rowlock shall be turned over all incoming and outgoing pipes.

The inverts of all manholes located at changes in alignment of the sewer shall be shaped to the incoming and outgoing pipes and smoothly curved from pipe to pipe to the top of invert at springline.

On line manholes, pipe shall be laid through the manhole and the upper half removed after the invert has been completed. Half pipe may be used.

As an alternate, manholes may be built of Class A concrete, precast or poured in place. Plans for concrete manholes must be approved by the Engineer. Forms may be of steel or clean lumber, assuring a smooth finished surface.

During the construction of each manhole, cast-iron steps conforming to the specifications for cast-iron manhole steps hereinbefore described, shall be set in place on the inside of the manhole, at the spacing shown on the plans. The top step shall not be more than 2 feet below the top of the manhole. The ends of the steps shall be firmly built in the wall, allowing the steps to project 3-1/2 inches from the inside of the manhole. Where shown on the drawings, manholes shall be built over existing sewers and the existing sewer plugged. The sewers requiring plugging will be filled with concrete for a length of not less than 2 feet.

On the manholes which are to be covered with standard cast-iron frames and covers, frames and covers of the dimensions and materials, as herein specified, shall be set in place.

All manholes will be measured and paid for as manholes of the appropriate depth as bid in the Proposal.

The depth of manholes shall be measured from the invert of the sewer to the top of the cast-iron frame and shall be paid for at the appropriate unit price bid.

Payment for all work included in this paragraph shall be included in the unit price for the various depth manholes and shall include all necessary labor, material and equipment for constructing the manholes, including additional excavation beyond the trench payline width and depth,

concrete base manhole steps, cast-iron frame and cover, backfilling and all other work necessary to construct the manhole in place.

16. PROTECTION OF POLE LINES, WATER AND GAS PIPES, AND ALL OTHER UNDERGROUND UTILITIES:

On the plans, for the work to be constructed under this Contract, is shown the record information which has been obtained from the owners of utilities for underground pipes or conduits which exist along the line of the proposed sewers. Service leads to abutting property are not shown. The Owner does not guarantee the accuracy of these locations, but merely indicates the information which has been obtained from the companies owning such underground pipes or conduits. The locations of utility poles and service boxes, visible at the ground surface, shown as noted at the time of the survey, may have since been changed. It is assumed that the Contractor will make a field inspection of the locations along which the sewers are to be constructed, and note all poles and overhead improvements which may affect his method of operation in the construction of the sewers at such locations.

The plans have been drawn to avoid existing utilities and structures insofar as is possible. If, during construction, it becomes necessary to move pipe lines, power poles, or any other existing utility structures to avoid conflicts in the in-place locations of new and existing lines, the Owner will be responsible for the cost of removal thereof.

It is not the intent of this specification that the Owner shall pay for moving and replacing existing pipe lines, power poles, or any other existing utility that may have to be removed and replaced in the same location for convenience in installing the lines required to be constructed under this Contract.

Such poles, overhead wires, underground pipes and conduits, including services, that may exist or may be encountered are to be protected or moved and replaced at the Contractor's expense except in the case of mains of public utilities located in public streets, in which case the removal or adjustment is to be carried out by the public utility company or owner. Any expense or inconvenience caused by their existence, and the necessary protection during the construction of the sewers adjacent thereto, shall be considered as covered and included in the price bid for "Excavation." The records of the existing utilities may not be complete or accurate. In order to minimize conflict in locations, the Contractor shall be required to locate the main by actual exposure or other means before the construction stakes are set out, in order that any required adjustments in alignment can be made. The cost of such location shall be considered as included in the price bid for excavation.

17. RESTORATION OF GRAVEL SURFACES:

All roadways with gravel, crushed stone, or other surfacing materials that do not have pavements of concrete or asphaltic concrete pavements, that are cut or damaged during the construction, shall be replaced with crushed stone or gravel as approved by the Engineer. Sufficient gravel or crushed stone shall be spread, as directed by the Engineer, to provide a usable surface in as good a condition or better condition than the surface destroyed.

Gravel or crushed stone used to restore surfaces shall be measured as the actual tons of material placed as authorized by the Engineer and shall be paid for at the unit price bid for "Gravel for Road Surfacing."

The unit price for "Gravel for Road Surfacing" shall include all labor, material and equipment required to restore the surfaces as required by these specifications.

18. TESTING OF GRAVITY SEWERS:

After the backfilling of the gravity sewers, the infiltration in each line shall be checked. The Contractor shall measure the infiltration at points designated by the Engineer with a weir or other suitable measuring device. The infiltration shall not exceed 500 gallons per inch of diameter per mile of pipe per day. Should the infiltration exceed the amount allowed, the Contractor shall repair the line to reduce the infiltration to the allowable limit. Payment for all work included in this Section shall be included in the payment for pipe in place as hereinafter specified.

19. TESTING OF FORCE MAIN:

The force main shall be tested to a pressure of 50 psi after the line has been backfilled. The leakage shall be measured by pumping into the line with a pump capable of maintaining the required pressure and metering the amount of water necessary to sustain the pressure for a period of four hours. The test when so conducted shall indicate a leakage of not more than 50 gallons per inch of pipe diameter per mile per day and no leaks shall become apparent on the surface of the ground. Should surface leaks become apparent, or should the leakage exceed that specified, the leaks shall be located and repaired and the line retested until it fulfills the above requirements.

Payment for all work included in this section shall be included in the payment for pipe in place as hereinafter specified.

20. PAINTING:

General. This work includes the field painting of all metal surfaces which are not buried in earth or masonry or specifically exempted as noted in this section, concrete surfaces where called for, and all pipe, where required or specified.

Mechanical equipment, electrical equipment, and similar items which have been specified with baked-on enamel, porcelain, laminated plastic finish or similar finish standard with the manufacturer shall not require field painting. The factory-built pumping station shall not require field painting. Any injury or damage to such finished surfaces prior to final acceptance of the work shall be remedied before final acceptance, and all costs for same shall be borne by the Contractor. Nameplates on any equipment shall not be painted.

Cast-iron pipe submerged in sewage or buried in the ground; stainless steel; copper; monel; brass; bronze and chrome surfaces shall not be painted.

The mixing, thinning and application of all paints herein specified and approved shall meet the recommendations of the respective manufacturers, in regard to weather and temperature, in particular for application and the use and type of thinner.

All painting shall be done in the best manner by skilled workmen and in accordance with the paint manufacturer's recommendation. Finished surfaces shall be free from runs, drops, ridges, waves, laps and unnecessary brush marks. The actual surface area covered per gallon of paint and the dry film thickness per coat shall be in accordance with the manufacturer's recommendations. All corners and crevices shall be completely coated. The dry film thickness and the continuity of painted ferrous metal surfaces will be subject to a field check by the Engineer. Dry film thickness shall be measured by an Elcometer or Mikrotest dry thickness gauge. The minimum thickness at any point shall not deviate more than 25 per cent from the manufacturer's recommended average thickness. Continuity shall be tested by a low voltage, wet sponge, transistorized device as manufactured by the K-D Company, Palo Alto, California.

It is the intent of the Contract to require a finished and workmanlike appearance on all surfaces and all surfaces shall be properly protected from corrosion as specified.

Preparation of Surfaces. All metal surfaces, prior to painting, shall first be thoroughly cleaned of all rust, mill scale, grease, oils, mud, dirt and other foreign matter. Cleaning shall be accomplished through the

use of wire brushes, chisels, hammers, or washing with water or benzine, as is necessary or as directed. Sandblasting, in an approved manner at point of manufacture, will be permitted on structural steel and rough steel castings or forgings; however, no sandblasting on or near mechanical or electrical equipment after assembly or installation will be permitted. Sandblasting shall be required of all metals to receive submerged metal paint (Poxitar) before being primed.

All concrete, prior to painting, shall be thoroughly cleaned of all dirt, dust, curing compounds, oils and other foreign matter. If the paint manufacturer requires etching of concrete surfaces prior to painting, surfaces shall be treated with a 10 per cent muriatic acid solution in an approved manner.

All cast-iron piping or fittings that are specified to receive a coating other than coal tar pitch, shall receive two coats of an approved sealing painting before application of the finished color coats.

All surfaces, concrete or metal, shall be clean and dry at the time of application of paint coatings, and at a temperature of not less than 50 degrees F.

Application. Paint for all metal surfaces shall be well rubbed or forced into the metal or under coats of paint by suitable stiff, round or oval brushes, brindled if the bristles are too long or flexible. Flat brushes, when allowed, shall not be wider than 4 inches.

No painting shall be performed when the temperature is below 50 degrees F., upon wet, damp or frosty surfaces, in wet, foggy weather, nor in a damp atmosphere except by permission of the Engineer and in the manner that the Engineer may approve. Sufficient heating and ventilating shall be provided at the Contractor's expense to keep the atmosphere and surfaces to be painted dry and warm until the paint has hardened. Any painting found to be defective shall be scraped off and repainted as the Engineer may order. Previous coats of paint must be dry before the addition of new coats, which in general, will be according to the manufacturer's recommendations in warm weather, and longer in cold, damp weather or in cold, damp locations. Before acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted or touched up as ordered by the Engineer. All paint shall be applied in strict conformance with manufacturer's specifications.

Each coat of paint shall be tinted to make it distinguishable from preceding coats. It is not the intent of these specifications to permit spray or roller painting, and if such is done it shall require written authority of

the Owner and shall be carried out in full accordance with the paints and equipment submitted for approval and as recommended by the paint manufacturer.

Protection. During the construction period, all electrical, mechanical and other equipment, apparatus and surfaces shall be protected from paint drippings by means of tarpaulins, burlap, wooden housings or other approved means of protection. After equipment, apparatus and piping has been erected and tested, or when ordered by the Engineer and just prior to the acceptance of the work, it shall be given the final coats of paint as herein provided.

Shop Painting. Shop painting shall be performed to the extent and as required under the various other parts of these Contract Documents. If not there particularized, it is intended generally that all exposed metal surfaces shall be given a minimum of one protective coat of paint or rust protective material which shall be compatible with and is acceptable to the approved manufacturer of the specified field paint.

Field Painting. Field painting shall be done as follows:

a. Metal Surfaces.

(1) All exposed piping shall not be required to be painted.

(2) Submerged metal surfaces, including fabricated bar racks, gates, etc., except cast-iron piping which shall not be painted, that have been primed, shall be painted after the spots have been power-brushed or sandblasted, with two coats of submerged metal cover paint. Paint shall be applied immediately after the spots have been cleaned.

b. Concrete Surfaces.

(1) Interior concrete surfaces of the pumping station wet well shall be given two coats of paint.

(2) All concrete surfaces except as specified in (1) shall not be required to be painted.

Payment for all work required in this paragraph shall be included in the appropriate unit price of the "Factory-Built Pumping Station" or the "Junction Chamber."

21. INSTALLATION OF ELECTRICAL EQUIPMENT:

a. Scope. The work covered in this section consists of furnishing all plant, labor, equipment, supplies and materials; and performing all operations necessary for the installation of a complete electrical service as shown on the plans and as herein specified for the sewage pumping station.

b. Rules and Regulations. The installation shall comply with the applicable rules and regulations of the National Electrical Code and the rules and regulations of local governing authorities.

c. Permits and Fees. The Contractor shall obtain all the necessary permits and after completion of the work shall submit a certificate of final inspection and approval from governing inspection authorities. The Contractor shall pay for all permits and inspection fees.

d. Power Service. Power is to be supplied by Union Electric Company. The Contractor shall install meter pole with conduit, conduit cap, conductors, line terminating rack, meter base (furnished by Union Electric Company), ground rod and ground wire, and disconnecting switch as required to complete the installation of a 3 phase, 3 wire, 480 volt service connection, all as indicated on the plans and in conformity with the requirements of Union Electric Company.

e. Grounding. All electrical equipment shall be grounded as required by the National Electrical Code and as recommended by the manufacturer of the equipment supplied and as indicated on the plans. Grounding materials shall be as specified in Section II. Ground rod shall be installed as shown on the drawings and shall be connected by bare copper ground wire to the meter base and the disconnect switch enclosures. The conduit system shall serve as the grounding system for all other electrical equipment.

Ground wire shall be connected to the ground rod by a molded weld, Cadwell or equal. Accessible connections shall be bolted. Insulated grounding bushings shall be used on conduits to the pump housing meter base, and disconnect switch, and shall be bonded to each enclosure with #6 stranded copper conductor.

f. Conduit and Wiring. All wiring shall be run in rigid heavy wall, galvanized or sherardized conduits complete with junction and outlet boxes and fittings to make a steel pipe system which is continuous mechanically and electrically. Conduit sizes shall be as indicated on the drawings and in accordance with the requirements of the National Electrical Code. Connections of conduits to cabinets and junction boxes shall be made using

grounding type bushings. Joints shall be made so that the ends of conduit butt together in the center of the couplings. No running threads couplings shall be used. All exposed conduit shall be run parallel or perpendicular to walls.

Hangers and supports, where used, shall be galvanized and fastened with rustproof anchor bolts embedded in concrete or masonry with suitable expansion shields. The use of wood or fiber plugs inserted in masonry or concrete will not be permitted.

Bends in conduit shall be made with an approved bending machine. Any deformed or injured conduit shall not be used in the work. Conduit ends shall be capped or plugged, except when working on a run, to exclude dirt and moisture. All conduit runs shall be free of obstructions, foreign matter, or moisture before wires are inserted.

Conductors shall be of the sizes and types as indicated on the drawings, shall be color-coded for identification and shall be continuous from box to box.

No wire shall be drawn into conduit until all work that might cause injury is completed. Only powdered soapstone shall be used as a lubricant where necessary.

h. Tests. After installation of all equipment is complete, all electrical equipment shall be tested in the presence of and as specified by the Engineer to demonstrate its ability to function as required by the system. The tests shall include, but not be limited to, testing of control circuits, motor rotation, switches and controls.

i. Payment. Payment for all work required in this paragraph shall be included in the unit price bid for the "Factory-Built Pumping Station."

22. INSTALLATION OF FACTORY-BUILT PUMPING STATION:

The factory-built pumping station shall be installed as called for on the plans and in these specifications, and in accordance with the written directions of the manufacturer of the equipment.

The manufacturer of the equipment shall provide the services of a factory-trained representative to perform initial startup of the pumping station. The factory-trained representative shall also instruct the Owner's operating personnel in the operation and maintenance of the equipment provided.

The sluice gate and flap gate shall be installed plumb and in a manner to reduce leakage to a minimum. The sluice gate shall operate without binding and all wedges shall be properly adjusted.

The payment for all work required in this paragraph shall be included in the unit price bid for the "Factory-Built Pumping Station." The unit price for the "Factory-Built Pumping Station" shall include the factory-built pumping station, the reinforced concrete base and wet well, 21-inch overflow sewer, gates, manhole frame and cover, excavation, backfilling, painting, electrical work, and all other work necessary to make a workable installation as required on the plans and in these specifications.

23. JUNCTION CHAMBER:

The junction chamber shall be constructed as required on the plans and in these specifications.

The flap gate shall be installed plumb and so there is no appreciable leakage through the gate at any time.

The unit price for the "Junction Chamber" shall include all concrete and reinforcing steel, excavation and backfill, bar racks, flap gate and all other labor, material and equipment as required by the plans and specifications.

24. CLEAN-UP:

After final backfilling and restoration of all surfaces to their original condition, all debris, extra pipe, and materials shall be removed from the site of the work by the Contractor, but none shall be disposed on private property until written consent of the owner or owners thereof has been filed with the Engineer.